

IPENZ Engineering Heritage Register Report

Kawarau Gorge Suspension Bridge

Written by: Karen Astwood
Date: 29 March 2011



The Kawarau Suspension Bridge, N.Z., circa 1882. H. P. Higginson, 'The Kawarau Suspension Bridge, N.Z.' in James Forrest (ed.), *Minutes of Proceedings of the Institution of Civil Engineers with Other Selected and Abstracted Papers*, Vol.68 (1882), London, p.248

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A. General information

Name: Kawarau Gorge Suspension Bridge

Alternative names: Kawarau Bridge

Location:

Kawarau River

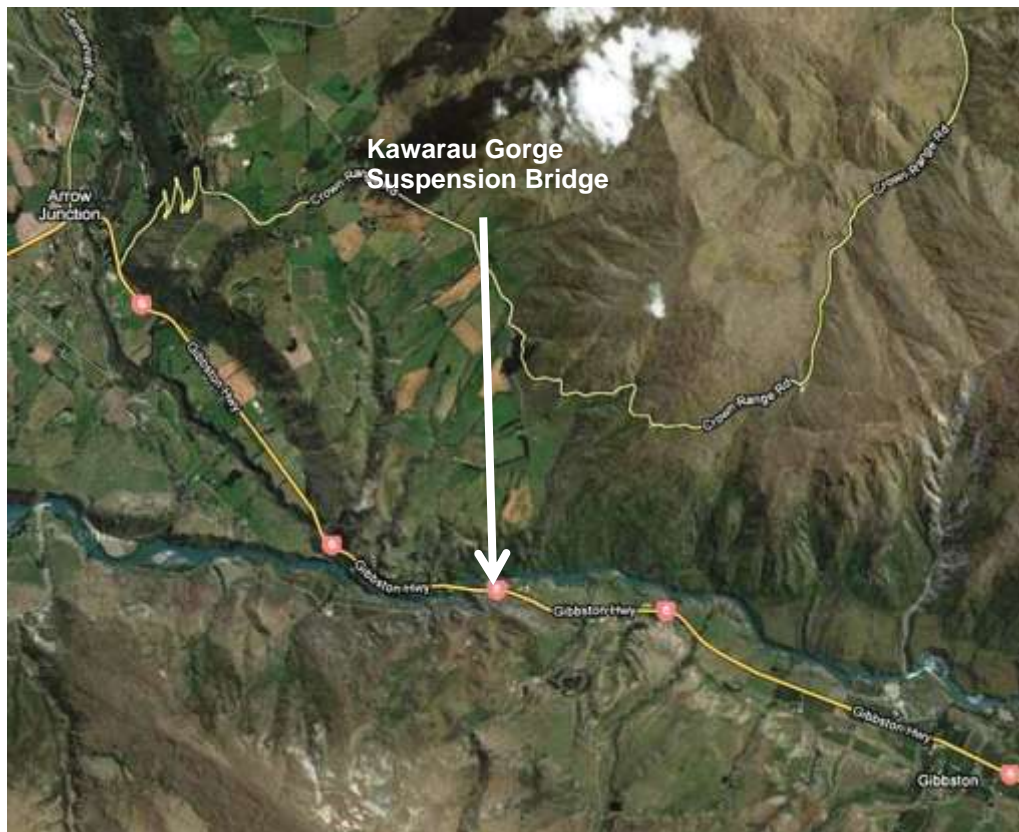
Gibbston

Otago

Geo-reference: (Centre of structure) Latitude: -45.009. Longitude: 168.899

Legal description: No legal description. Abutments adjoin Sec 63 and 64, Block 1, Kawarau Survey District

Access information: The bridge is set within a Department of Conservation reserve and is used by the commercial bungy jumping venture known as AJ Hackett Bungy. This is signposted on State Highway 6/Gibbston Highway northwest of Gibbston township, and immediately east of the current highway bridge across the Kawarau Gorge. The structure is visible from the highway when approaching from the west.



Location map courtesy of GoogleMaps

City/District Council: Queenstown-Lakes District Council

IPENZ category: Engineering Work

IPENZ subcategory: Infrastructure – Bridge

IPENZ Engineering Heritage number: 56

Date registered: 19 April 2011

IPENZ recognition: Plaque (1990 item)

Other heritage recognition:

- *New Zealand Historic Places Trust:* Category I historic place (Record. no.50)
- *Local Authority District Plan:* Queenstown-Lakes District Plan, Inventory of Protected Features (Partially operative December 2008), Appendix 3, Ref 41
- *Other:* N/A

B. Description

Summary

The Kawarau Gorge Suspension Bridge is an impressive structure which crosses a ravine forged by the Kawarau River, near Gibbston in Central Otago. This important landmark was completed in late 1880, and is an exemplar of the contemporary regional vernacular type of bridge.

Along a key route to the Central Otago goldfields, in the late nineteenth century people campaigned hard for a road bridge to replace the existing punt service across the Kawarau River between Cromwell and Queenstown. As such, the Lake County Council launched a comprehensive roading programme in the late 1870s, which included an extensive expansion of the roads and the construction of the Kawarau Gorge Suspension Bridge. After a delayed start, the design and initiation of construction in 1879 went apace under the leadership of Dunedin consulting engineer, Harry Pasley Higginson (1838-1900). Assisting Higginson were two talented young engineers in his employ: Arthur Robert W. Fulton (1853-1889), and Walter Cleave Edwards (1862-1929). The success and longevity of this suspension bridge with monumental schist masonry towers also seems to be due to the experienced local contractors engaged on the project: John McCormick and James Sutherland.

For over 80 years the Kawarau Gorge Suspension Bridge was a key link in the road network of the area and State Highway 6. However, by the mid twentieth century modern traffic requirements were over and above the capacity of the ageing single-lane bridge, and therefore it was replaced by a new highway bridge in 1963. However, in 1980s the Kawarau Gorge Suspension Bridge was given a new lease on life when it became the site of the first commercial bungy jump in the world, started by A. J. Hackett (b.1958) and Henry van Asch in 1988. The following year a restoration project was undertaken by the bridge's owner, the Department of Conservation, which was largely funded from proceeds generated by the bungy jump. It was during this period that components of the bridge, such as its timber deck, were repaired and restored, and accretions associated with the bungy jumping business began to accumulate.

The Kawarau Gorge Suspension Bridge is a structure of outstanding importance in New Zealand's engineering heritage as the legacy of the eminent late nineteenth

century New Zealand engineer, Higginson, and is a lasting tribute to the technical skill of those in his project team. A major infrastructure project at the time, this landmark bridge is also of considerable heritage value as a vestige of a formerly vital Kawarau River crossing and state highway bridge.

Historical narrative

With its source at Lake Wakatipu, the Kawarau River strikes a general passage eastward, connecting with several other rivers, including the Shotover and Arrow Rivers, before it eventually joins the Clutha River near Cromwell. A late nineteenth century description of the Kawarau River detailed that for the first few miles from its source the river's current was "sufficiently slow to admit cattle swimming easily across: afterwards it become more rapid... Lower down it enters an abrupt rocky gorge, through which it has a torturous course of eighteen miles before entering the valley of the Clutha."¹

The discovery of gold in the 1860s saw a rapid influx of people into Central Otago as prospectors and support industries were drawn to the region. Indeed, throughout the early history of the Kawarau Gorge Suspension Bridge there was a gold dredge based nearby.² The first bridge across the Kawarau River was constructed in 1873 and was located south of Cromwell.³ Until the completion of the Kawarau Gorge Suspension Bridge seven years later, people and goods travelling further along the main road between Cromwell and Queenstown were required to cross the Kawarau Gorge using punt services which had been operating by 1867.⁴ Therefore, in the late 1870s the Lake County Council, with substantial Central Government funding support, embarked on a determined programme of improvements for the transport route which passed through the Kawarau Gorge. This was an expensive exercise because of the relative remoteness of the location, the steep gradients involved, the necessity of cuttings through rock, and the series of bridges which were required to cross various rivers.⁵

However, once decided upon, planning and undertaking this programme of road works seems to have taken some time to get off of the ground, which tested the patience of local people. For example, several surveys were done to try and determine the best site for the Kawarau Gorge Suspension Bridge, but it was not until Harry Pasley Higginson's (1838-1900) survey that a suitable location was found. Higginson was particularly well qualified to investigate the potential bridge site being familiar with the geology and waterways of the area through his involvement on the

¹ R. Carrick, *A Romance of Lake Wakatipu: Episodes of early goldfields life in New Zealand*, Wellington, 1892, p.112

² *Otago Witness*, 25 March 1903, p.23

³ 'Kawarau Suspension Bridge,' *Bruce Herald*, 8 July 1873, p.7

⁴ A. Cook, *The Gibbston Story*, Dunedin, 1985, p.7

⁵ H. P. Higginson, 'The Kawarau Suspension Bridge, N.Z.' in James Forrest (ed.), *Minutes of the Proceedings of the Institution of Civil Engineers*, Vol.68 (1882), London, pp.248-49; Cook, p.15

commission which investigated the disastrous Clutha River flood of 1878.⁶ The slow progress in regard to the Kawarau Gorge bridge led the *Otago Witness* to question the management of the project, asking:

...why the last survey was not the first? A vast amount of animus and ink might have been saved had our County Council acted with a little more energy, previous surveyors with more judgement, and one or two private individuals more patriotically.⁷

Despite these remonstrations the author did go on to note, with some relief, that tenders had been called for the bridge and its approaches, and that construction was planned to start in spring that year.⁸

After this slow start, under Higginson's leadership the planning of the Kawarau Gorge Suspension Bridge then moved rapidly. Remarkably, Higginson designed the bridge within 16 days of getting the go ahead. In his concept for the structure Higginson was particularly attentive to the fact that it would be difficult and expensive to bring materials in to the challenging location and therefore, as much as possible, the Kawarau Gorge Suspension Bridge was to be constructed from materials available in the immediate vicinity.⁹ This kept the price down somewhat, although it was still a very costly structure at £5373.¹⁰ The cost for the bridge was also affected by the fact that its proximity to the goldfields greatly inflated the wage that labourers were prepared to work for, and as such they were paid premium rates.¹¹

Upon his death in 1900 Higginson was described as "a gentleman well-known all over New Zealand as an eminent engineer, who took a prominent part in connection with the public works of the colony."¹² After being articled to the prestigious firm of Sir William Fairburn (1789-1874) in Manchester, Higginson worked in various engineering roles in Russia and India before immigrating to New Zealand in 1872.¹³ His first position was as Superintending Engineer for Railways and other South Island public works projects, and then in 1878 Higginson entered into private practice in Dunedin. After designing the Kawarau Gorge Suspension Bridge, Higginson later

⁶ F. W. Furkert, *Early New Zealand Engineers*, Wellington, 1953, pp.190

⁷ *Otago Witness*, 28 June 1879, p.11

⁸ *Ibid.*; *Otago Daily Times*, 19 June 1879, p.2

⁹ *Wanganui Herald*, 25 August 1882, p.2

¹⁰ Higginson, p.252

¹¹ M. Wright, *New Zealand's Engineering Heritage, 1870-2000*, Auckland, 1999, p.26

¹² 'The Late Mr H.P. Higginson,' *Star*, 28 February 1900, p.3

¹³ *Ibid.*

went on to become the Chief Engineer for the Manawatu and Wellington Railway, and then the Engineer and Manager of the Wellington Gasworks.¹⁴

Also engaged to work on the Kawarau Gorge Suspension Bridge was Arthur Robert W. Fulton (1853-1889). Fulton was a talented 26 year old assistant engineer to Higginson, and was the on-site overseer of the day-to-day work.¹⁵ Arthur was the elder brother of important New Zealand engineer and surveyor, James Edward Fulton (1854-1928), and was forging a promising career, fostered by Higginson, when he died prematurely of typhoid fever at the age of 35. Arthur was described as “energetic and painstaking” and it was thought that he “...in all probability would have made his mark in his profession had he lived longer.”¹⁶ Upon Arthur’s death James succeeded his brother as the manager and locomotive superintendent of the Wellington to Manawatu Railway.¹⁷

Along with Fulton, a further gifted assistant engineer who would have been engaged on the Kawarau Gorge Suspension Bridge’s construction was Walter Cleave Edwards (1862-1929). Edwards also worked for Higginson during this period, and immediately after his apprenticeship Edwards went on to be the Assistant Engineer on the construction of the Wellington to Manawatu Railway, before having a number of similar posts elsewhere in New Zealand. In the closing years of the nineteenth century Edwards went to South Africa, eventually becoming a Chief District Engineer of Public Works.¹⁸

However, it was not only Higginson and his assistants who brought a combination of experience and talent to the Kawarau Gorge Suspension Bridge project. The main contractor, John McCormick, was a seasoned local contractor who had previously worked on other bridges in the region, such as the first bridge across the Kawarau Gorge in 1873, and the Victoria Bridge further along the river in 1874.¹⁹ As well as this, James Sutherland, who had worked on earlier road projects in the area, is said to have been the foreman mason on the bridge’s construction.²⁰

¹⁴ Furkert, pp.189-90

¹⁵ Cook, p.16; Furkert, p.171

¹⁶ *Otago Witness*, 1 August 1889, p.14

¹⁷ P. Lowe, 'Fulton, James Edward - Biography', from the *Dictionary of New Zealand Biography*. Te Ara - the Encyclopedia of New Zealand, URL: <http://www.TeAra.govt.nz/en/biographies/3f15/1> (updated 1 September 2010)

¹⁸ Furkert, pp.161-62

¹⁹ *Bruce Herald*, 8 July 1873, p.7; Cook, p.15. The Victoria Bridge was demolished in 1956, Cook, p.66

²⁰ Cook, p.11

In the hands of this team of able people the Kawarau Gorge Suspension Bridge was completed by mid-December 1880 and opened for traffic.²¹ The bridge was then officially opened the following month. Higginson's engineering excellence was recognised in 1882 when his paper on the project was awarded the esteemed Telford Premium Award by the Institution of Civil Engineers in London. This prize remains the highest awarded by the institution for a paper, and was instigated in 1835 following the bequest of Thomas Telford (1757-1834), the Institution's first president.²²

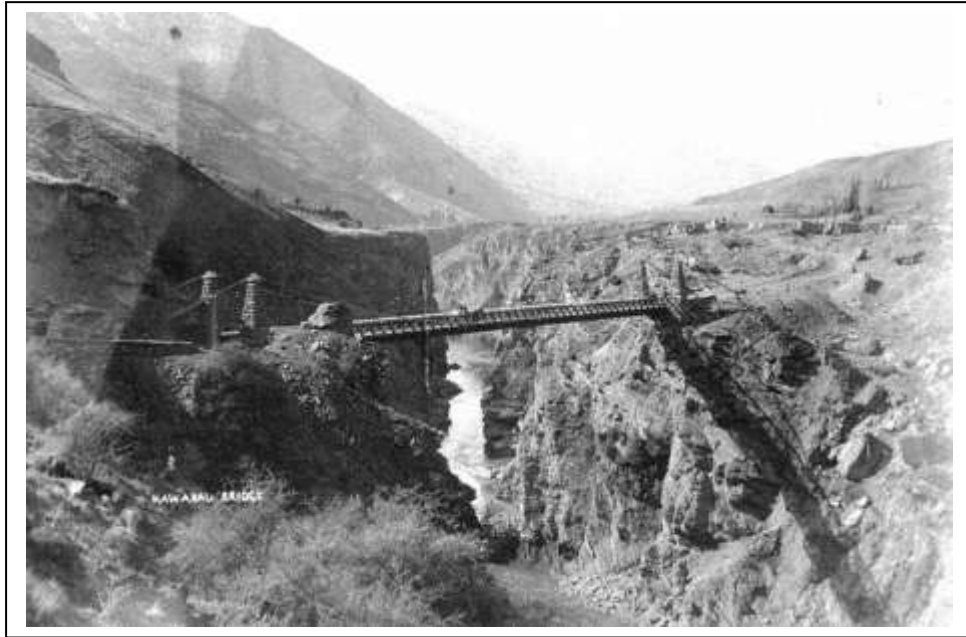


Figure 1: An early view of the Kawarau Bridge, spanning the deep river gorge. A. Cook, *The Gibbston Story*, Dunedin, 1985, p.15

Only a few years after construction the Kawarau Gorge Suspension Bridge was said to shake and tremble when walking-pace coach traffic crossed it. Therefore, unsurprisingly by the mid twentieth century heavier vehicles and increased traffic tested the capacity of the single lane structure.²³ Traffic woes were compounded by the sharp approach on the northern side. This meant that the bridge was not easily passable by large coach buses which had to “back and fill”²⁴ to navigate it. As such, in 1963 the Kawarau Gorge Suspension Bridge was succeeded by a new open-spandrel steel arch highway bridge (Figure 2).²⁵

²¹ *Otago Witness*, 11 December 1880, p.12

²² ‘Telford Premium,’ *losts.net*, http://losts.net/Telford_Medal (accessed 8 February 2011)

²³ Wright, p.26

²⁴ Cook, p.16

²⁵ See R. J. P. Garden, ‘Erection of an Arch Bridge over the Kawarau River,’ *N.Z. Engineering*, Vol.18:10 (15 October 1963), pp.361-68



Figure 2: The 1963 highway bridge with Kawarau Gorge Suspension Bridge in the background, January 2006. Photograph courtesy of Lloyd Smith

The Kawarau Gorge Suspension Bridge was recognised as a place of outstanding heritage value by the New Zealand Historic Places Trust in 1981. Late in that decade the bridge, which was managed by the Department of Conservation (DoC), became the site of the world's first commercial bungy jump when Alan John (A.J.) Hackett (b.1958) and Henry van Asch began offering people the chance to dive over 40 metres (m) off the structure in 1988. The establishment of the Kawarau Bridge Bungy further cemented the Queenstown region's burgeoning reputation as a thrill-seekers paradise, which had begun in the 1970s after a Hamilton Jet began to take tourists darting along the Shotover River.²⁶

This new use for the structure was negotiated between DoC, and Hackett and van Asch, and ensured the future feasibility of the structure for its owners. Indeed, the tourist attraction seems to have been an immediate success because the bulk of the funds for a six-month-long restoration of the Kawarau Gorge Suspension Bridge, costing \$100,000, was quickly generated from the \$5 per jump royalty that DoC

²⁶ Margaret McClure, 'Tourist industry - Tourism boom', Te Ara - the Encyclopedia of New Zealand, URL: <http://www.TeAra.govt.nz/en/tourist-industry/6> (updated 5 March 2010)

received under the lease arrangement. The restoration was completed in April 1990 and the Kwarau Bridge Bungy continues to be a significant tourist attraction.²⁷

²⁷ L. Smith to K. Astwood, 23 March 2011. IPENZ. Brian Ahern (d. 2000) was a senior local DoC officer who is noted as being particularly instrumental in the establishment of the Kwarau Bridge Bungy. This important contribution by Ahern has been commemorated by AJ Hackett Bungy through the creation of a seat and plaque at the Kwarau Gorge Suspension Bridge site.

Social narrative

Bridges were of great importance around New Zealand as European settlement took hold because they were a means of mitigating the high death toll from drowning. Bridges achieved this by eliminating the need to ford or ferry across potentially dangerous waterways, such as the fast flowing and flood-prone Clutha River, and its tributaries like the Kawarau River.²⁸ Another argument for the construction of bridges was that without them these rivers were often impassable for prolonged periods or took a while to cross safely. For example, the punt at Morven Ferry, which operated from the late 1860s close to the eventual site of the Kawarau Gorge Suspension Bridge, is recorded as having taken upwards of an hour to navigate when the Kawarau River was high.²⁹

It was for these reasons of wellbeing and efficiency that local people put concerted pressure on the Lake County Council to improve the transport route through the gorge and create safe river crossings, like the Kawarau Gorge Suspension Bridge.³⁰ The area where the Kawarau Gorge Suspension Bridge crosses the river was particularly dangerous and susceptible to flooding because it is here that discharges from the Shotover and Arrow Rivers combine with the Kawarau River, greatly enhancing its flow.³¹ Another advantage of the bridge for the local community was that it enabled heavy farm and mining equipment to be brought in, and therefore the Kawarau Gorge Suspension Bridge was of considerable economic value to the area.³²

Because of these benefits the bridge's completion was greatly anticipated by the local community, which was reflected in calls for a public opening of the structure.³³ Its importance locally was demonstrated by this being granted and the day in early January 1881 being "made a universal holiday from one end of the county to the other," with approximately 500 people in attendance at the opening ceremony.³⁴

²⁸ Malcolm McKinnon, 'Otago places - Clutha River/Mata-Au', Te Ara - the Encyclopedia of New Zealand, URL: <http://www.TeAra.govt.nz/en/otago-places/12> (updated 19 August 2009); G. Thornton, *Bridging the Gap: Early bridges in New Zealand, 1830-1939*, Auckland, 2001, p.15

²⁹ Cook, p.7

³⁰ Thornton, p.185

³¹ Higginson, p.249

³² Cook, p.19

³³ *Otago Witness*, 11 December 1880, p.12

³⁴ 'Opening of the Kawarau Bridge,' *Otago Witness*, 8 January 1881, p.11

After its completion in 1880 the Kawarau Gorge Suspension Bridge quickly became a celebrated structure and landmark.³⁵ Even though the main highway was diverted away from it in the 1960s, the Kawarau Gorge Suspension Bridge remained a popular tourist site and in the early 1980s it was said that “there is hardly a moment in the day when cars are not drawn up at its approaches.”³⁶



Figure 3: Kawarau Bridge, (near Arrowtown) Otago, N.Z. Cook, p.16

This landmark status has been enhanced since 1988 when the commercial bungee jump off of the Kawarau Gorge Suspension Bridge opened. Bungee jumping has been described as arguably “the highest-profile New Zealand invention.”³⁷ Because Kawarau Bridge Bungee is based on the Kawarau Gorge Suspension Bridge this structure currently has national and international fame that attracts tens of thousands of people annually, ranking it amongst New Zealand’s top tourist attractions, and making the Kawarau Gorge Suspension Bridge one of the most photographed New Zealand bridges.³⁸

³⁵ ‘The Tourist,’ *Otago Witness*, 18 April 1885, p.26

³⁶ Cook, p.19

³⁷ Mark Derby. ‘Inventions, patents and trademarks - The ‘no. 8 wire’ tradition’, *Te Ara - the Encyclopedia of New Zealand*, URL: <http://www.TeAra.govt.nz/en/inventions-patents-and-trademarks/1> (updated 26 November 2010); ‘Kawarau Bridge Bungee,’ AJ Hackett Bungee New Zealand, URL: <http://www.bungee.co.nz/kawarau-bungee-centre/kawarau-bungee> (accessed 14 March 2011)

³⁸ T. Williams, *101 Indigenous Kiwis: How New Zealanders changed the world*, Auckland, 2006, p.152

Physical narrative

Completed in 1880, the Kawarau Gorge Suspension Bridge was described as a “model structure in design and workmanship,”³⁹ and said to have been the second largest bridge project to be undertaken by a County Council in New Zealand to that date. The bridge’s span of 91.4m was also among the longest in the country at the time.⁴⁰

A striking feature of this structure is its monumental towers. These taper from a base of 2.7m inwards to a 1m square, and the suspension cables are carried over top.⁴¹ The use of schistose rock ashlar masonry for the towers was typical of many early suspension bridges in Central Otago, and the blocks of stone are thought to weigh two or more tonnes each.⁴²

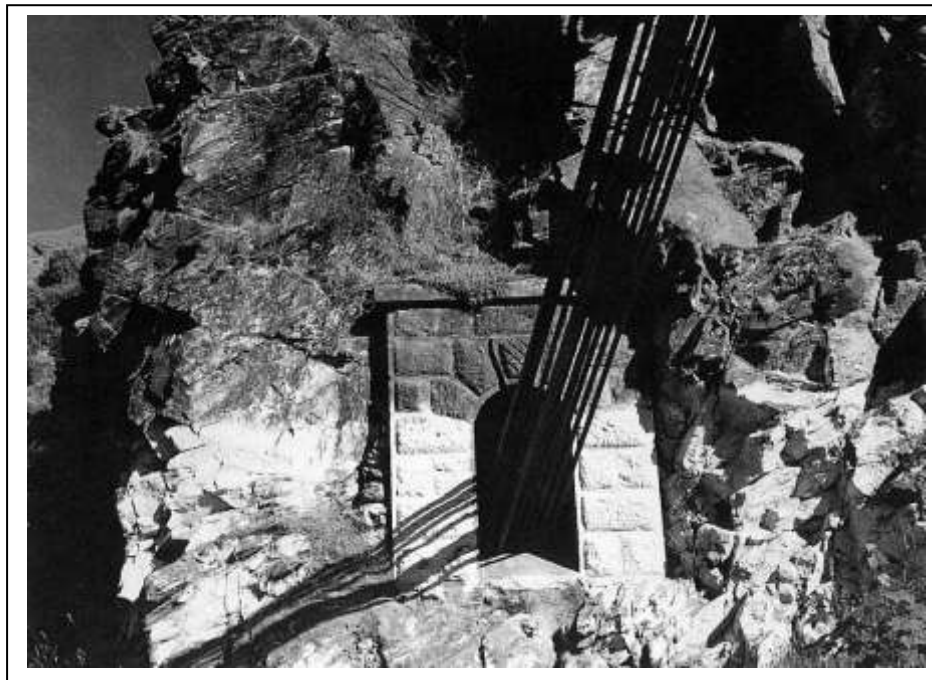


Figure 4: One of the northern anchorage tunnels. Thornton, p.184

On the north side the suspension cables are anchored in tunnels dug into the rock face (Figure 4). Initially the southern side of the bridge was to be secured in the same horizontal fashion, but excavations revealed that the geology was unsuitable for this method. Therefore, the centre line of the bridge was shifted several metres in order

³⁹ Cook, p.15

⁴⁰ Ibid.; ‘Opening of the Kawarau Bridge’

⁴¹ Thornton, 185

⁴² Higginson, p.250

for the suspension cables to be anchored in vertical shafts.⁴³ This was the only diversion from the original plans, which Higginson prepared in 16 days, making the speed with which the bridge was formulated even more remarkable.⁴⁴ Unusually, and in a move dictated by the high winds frequent in the gorge, the anchorages and towers are not aligned with each other because Higginson employed an American practice of using cables with a slight horizontal curve in order to give the structure greater lateral stability.⁴⁵



Figure 5: Kawarau Gorge Suspension Bridge prior to bungy jumping venture. Thornton, colour plate, p.11

The standard practice in previous Central Otago suspension bridge had been to use wire ropes spliced together, which were cheaper but potentially less effective due to them having weaker spots at the splice. However, taking into account the significant lateral strains posed by the intense winds that pervade the Kawarau Gorge, Higginson opted for 28 custom sized galvanised steel cables to carry the deck.⁴⁶ While most of the materials for the bridge were sourced locally, such as the stone, the majority of the timber, and also the ironwork, these 123 millimetre circumference

⁴³ Cook, p.16

⁴⁴ Higginson, p.252

⁴⁵ Thornton, p.185; Higginson, p.249

⁴⁶ Cook, p.16

cables had to be imported from English manufacturers Warrington Wire Rope Company.⁴⁷

The deck bridge's is 3.6m wide and 42m above the normal river level. The deck and stiffening truss are constructed from red beech, with some instances of Australian ironbark in the braces and filling blocks.⁴⁸ This material would have been replaced over the history of the structure when necessary, including during the late 1980s when the Kawarau Gorge Suspension Bridge was restored by DoC.⁴⁹

When the structure began being used as the stage for a commercial bungy jumping enterprise, related apparatus began to accrue on the bridge. This includes a shelter over the bungy platform connected to the exterior of the bridge's west side catenary and stiffening truss, slightly south of the centre of the bridge. The launching platform is below deck level and various framing and support structures for this, and the bungy cords, span the width of the deck. Immediately beneath the deck and alongside the abutment on the south side of the bridge is a large viewing platform, and a visitor experience centre is also present on that side of Kawarau Gorge Suspension Bridge.

Key physical dates

1879	Construction begun
December 1880	Completed
October 1988 – April 1989	Restoration project

⁴⁷ Wright, p.26; Thornton, p.185

⁴⁸ Thornton, p.185; L. Smith to K. Astwood

⁴⁹ Williams, p.21

C. Assessment of significance

The Kawarau Gorge Suspension Bridge has outstanding engineering heritage importance as a remarkable structure designed by notable New Zealand engineer Harry Pasley Higginson. This bridge was Higginson's masterpiece and its longevity is attributed to team of the talented engineers and experienced craftsmen engaged on the project. The Kawarau Gorge Suspension Bridge has considerable significance as an exemplar of the once vernacular bridge type in Central Otago, and as a structure which, between 1880 and 1963, was an important asset within the national road network. The visual impact of this impressive structure has meant that it has been a landmark since its inception, and as the site of the first commercial bungy jump in the world, the Kawarau Gorge Suspension Bridge continues to be one of New Zealand's top tourist attractions.

Therefore, Kawarau Gorge Suspension Bridge is of sufficient engineering heritage significance to merit inclusion on the IPENZ Engineering Heritage Register.

D. Supporting information

List of supporting documents

Link to: 'Kawarau Bridge Bungy,' AJ Hackett Bungy New Zealand, URL:
<http://www.bungy.co.nz/kawarau-bungy-centre/kawarau-bungy> (accessed 14 March 2011)

Link to: Kawarau Gorge Suspension Bridge, New Zealand Historic Places Trust Register,
<http://www.historic.org.nz/TheRegister/RegisterSearch/RegisterResults.aspx?RID=50>

Link to: Bridges: New Zealand historic heritage conservation, Department of Conservation, <http://www.doc.govt.nz/conservation/historic/historic-heritage-topics/bridges/>

Attach to Register entry page: Higginson article (see below)

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Star, 28 February 1900

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